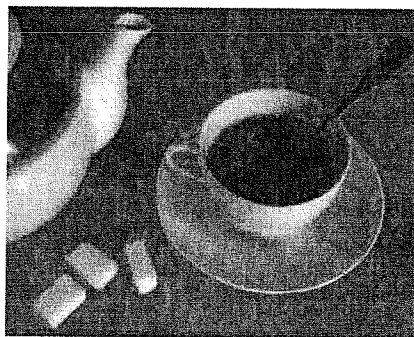


# SOLUBILITY CURVES POGIL

## Why?

Solubility is a measure of the amount of solute that will dissolve in a given amount of solvent. A solubility curve quantifies the amount of solute in a given volume of solvent at a given temperature in graphic form. Chemists use this information when preparing solutions. Recall that a solution is a combination of two or more substances combined in a homogenous mixture. Have you ever noticed the difference in the amount of fizz in cold pop versus warm pop? Can you dissolve as much sugar in hot coffee versus iced coffee?



## Learning Objectives

- Determine solubilities based on information presented in a table or a graph.
- Determine the amount of solute in a given amount of solvent based on solubility curves.
- Distinguish solubility trends at standard pressure between solids and gases with changes in temperature.

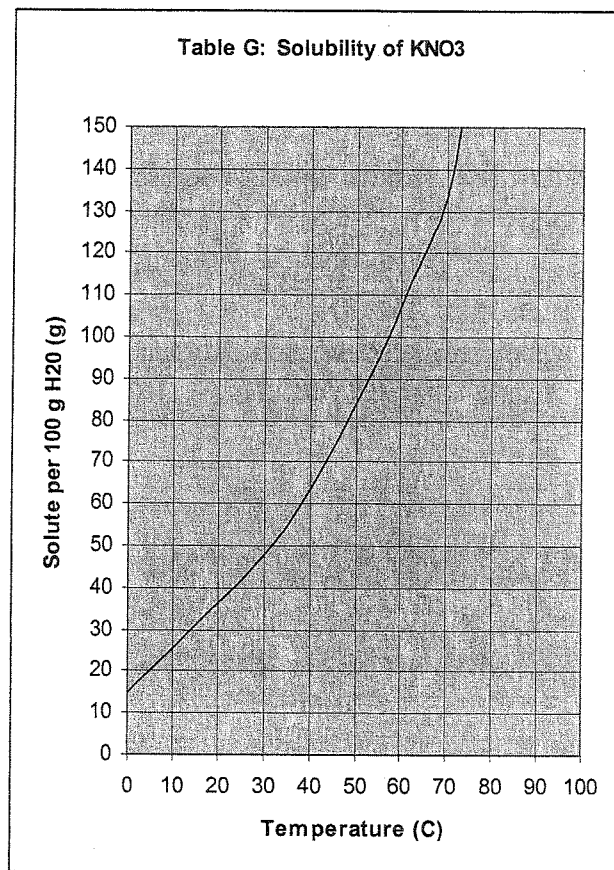
## Pre-requisites

- \* solute
- \* solvent
- \* solubility
- \* homogenous mixture

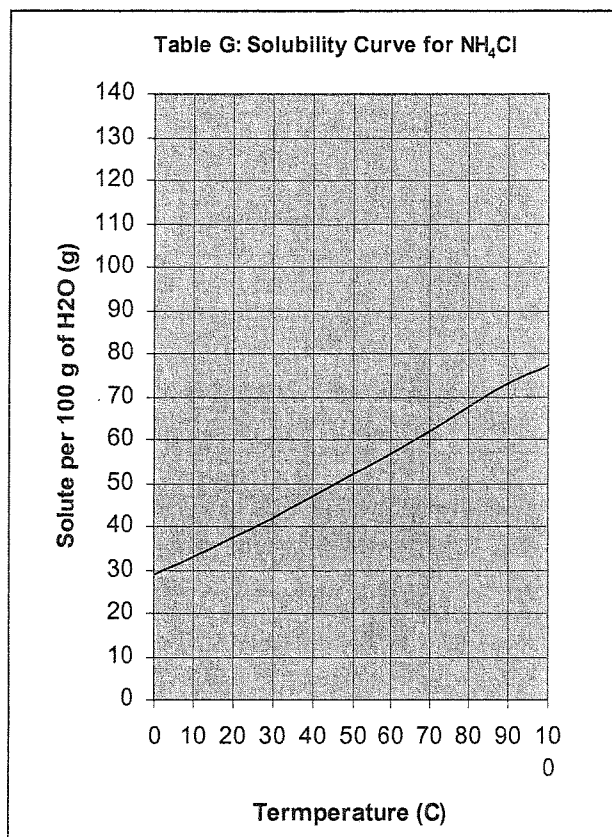
## Vocabulary

- Saturated
- Unsaturated
- Supersaturated

Model 1:



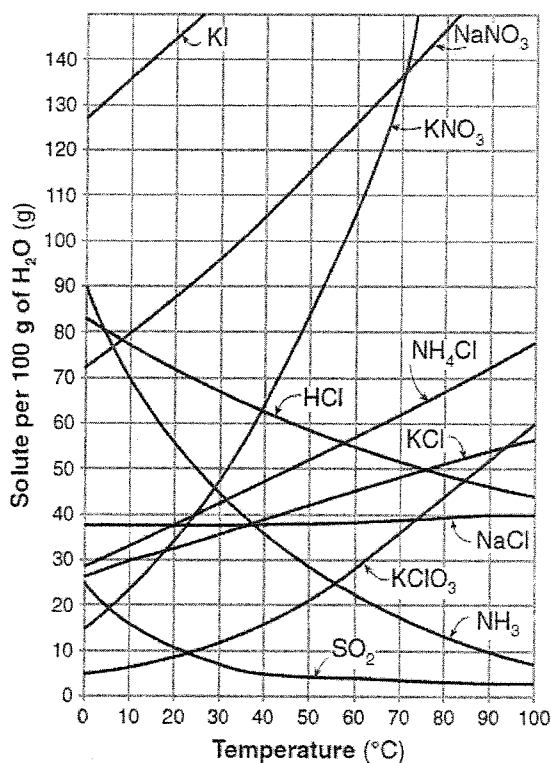
1. The y-coordinate for the points plotted on this curve is the maximum grams of solute in what amount of solvent?
2. What is the solute for this curve?
3. State the relationship between temperature and amount of solute dissolved for this substance.
4. What is the maximum amount of KNO<sub>3</sub> (s) that 100 g H<sub>2</sub>O can hold at 20 °C?
5. The points plotted on this curve are from data of the amount of solute that will saturate 100 g of water. What does the term saturated mean in this context?
6. What amount of KNO<sub>3</sub> (s) will saturate 100 g of water at 30 °C? Explain how you arrive at this answer.
7. What amount of KNO<sub>3</sub> (s) will saturate 200 g of water at 30 °C? Explain how you arrive at this answer.
8. If a solution were made from 50 g of KNO<sub>3</sub> (s) in 100 g of water at 60 °C, how much more KNO<sub>3</sub> (s) would it take to saturate the solution? Explain how you arrive at this answer.
9. A saturated solution of KNO<sub>3</sub> is prepared in 100 g water at 65 °C. If the solution were cooled down to 25 °C, how much excess would settle out (precipitate)?



- What is the name of the solute for this curve?
- State the relationship between temperature and amount of solute dissolved for this substance.
- How many grams of solute are needed to saturate 100 g of water at  $50^\circ\text{C}$ ?
- If the solution were made with 30.0 g of  $\text{NH}_4\text{Cl(s)}$  in 100 g water at  $50^\circ\text{C}$ , it would be called **unsaturated**. What does the term unsaturated mean in this context?
- What term (saturated or unsaturated) would be used to describe a solution made with 10 g of  $\text{NH}_4\text{Cl (s)}$  at  $25^\circ\text{C}$  in 100 ml of water? Explain your answer.
- How much more solute would it take to saturate the solution in question #5. Explain how you arrive at this answer.
- If a solution were made with 62 g of  $\text{NH}_4\text{Cl}$  at  $70^\circ\text{C}$  in 200 ml water, would it be saturated or unsaturated? How much more solute would be needed to saturate 200 ml water? Show necessary calculations.
- You want to prepare 100 g of a **supersaturated** solution of  $\text{NH}_4\text{Cl (s)}$  at  $60^\circ\text{C}$ . How much solute would you need to add to the 100 g of water? Explain how you arrive at this answer.

Exercises: This graph is taken from the NYS Chemistry Reference Tables

Table G Solubility Curves



1. What term is used to describe a solution of 90.0 g KNO<sub>3</sub> (s) in 100 g water at 40 °C?

\_\_\_\_\_

2. What term describes a solution made with 28 g of KClO<sub>3</sub> (s) in 100 g water at 60 °C?

\_\_\_\_\_

3. a) How many grams of NaNO<sub>3</sub> (s) will dissolve in 100 g of water at 20 °C?

\_\_\_\_\_

b) How many grams at 60 °C? \_\_\_\_\_

4. How many grams of NH<sub>4</sub>Cl (s) will dissolve in 1 liter of water at 50 °C?

\_\_\_\_\_

Show necessary calculation here:

5. Ninety grams of NaNO<sub>3</sub> (s) is added to 100 g of water at 0 °C. With constant stirring, to what temperature must the solution be raised to produce a saturated solution with no solid NaNO<sub>3</sub> remaining?

Calculations:

\_\_\_\_\_

6. 100 g of water is used to make a saturated solution of KCl (s) at 10 °C. How many more grams of KCl could be dissolved if the temperature were raised to 100 °C?

Calculations:

\_\_\_\_\_

7. A saturated solution of KNO<sub>3</sub> in 200 g of water at 50 °C is cooled to 20 °C. How much KNO<sub>3</sub> will precipitate out of solution?

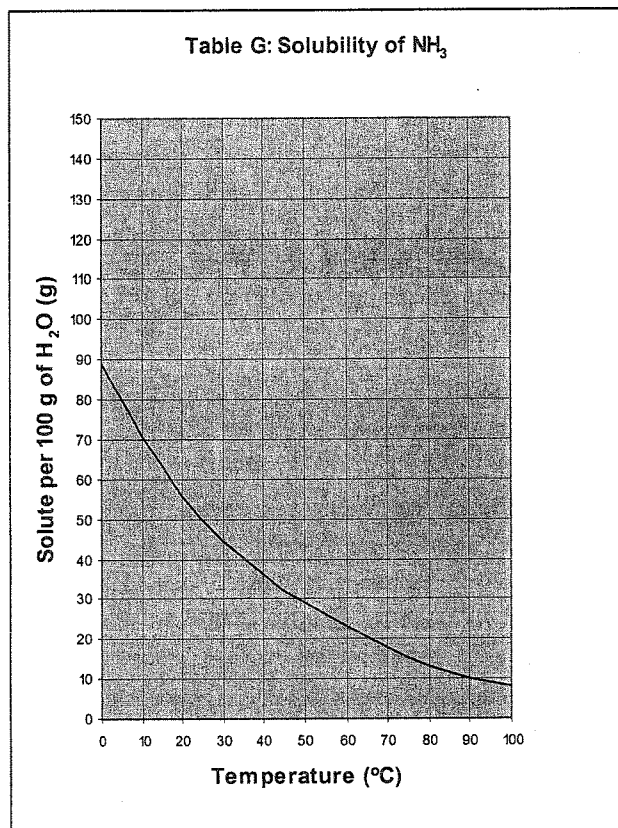
Calculations:

\_\_\_\_\_

## Solubility Curves POGIL

### Part 2

#### Model 3



1. How many grams of ammonia ( $\text{NH}_3$ ) are needed to saturate 100 g of water at 20 °C?
  2. What term is used to describe a solution of 20 grams of ammonia in 100 ml water at 50 °C?
  3. What is the relationship between temperature and solubility of ammonia?
  4. Compare the trend in solubility for ammonia to the solubility of  $\text{KNO}_3$  in Model 1 and  $\text{NH}_4\text{Cl}$  in Model 2. Describe your observation of the trends.
5. At standard pressure,  $\text{KNO}_3$  and  $\text{NH}_4\text{Cl}$  are both solids and  $\text{NH}_3$  is a gas. Using Ref Table G, make a generalization about the solubility of a solid in regards to temperature versus the solubility of a gas in regards to temp.

6. Based on # 5, use the NYS Reference table G to list substances that are gases and substances that are solids.

Substance	Solubility trend with increase in temp	Gas or Solid
KCl		
$\text{SO}_2$		
$\text{NaNO}_3$		
HCl		
$\text{KClO}_3$		

7. Suggest a reason why solubility decreases with an increase in temp for a gas but not for a solid.

**Problems:**

1. Joni and her sister Jennifer were at Tim Horton's. Joni ordered a coffee with 2 sugars and Jennifer ordered an iced coffee with 2 sugars both no cream. When the sisters sampled each other's drinks, Jennifer noticed that hers was not as sweet tasting and went back to the counter. Does she have a valid complaint that the cashier did not put the right amount of sugar in her drink?

---

---

---

---

2. Fish need dissolved oxygen gas in water to live. Wildlife Officers have documented that there tends to be more Fish Kills (large die-offs) in summer months as compared to winter months. Explain in terms of what you have learned in this activity.

---

---

---

---

3. Billy and Mike head to the kitchen to get a can of pop but there is only one left in the fridge and the rest are sitting on the counter. Whose soda pop has more fizz? Explain in terms of what you have learned in this activity.

---

---

---

---